

1 **First sea turtle remains (Pan-Chelonioida) from the Eocene of Algarrobo,**
2 **central Chile**

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21

22 **Abstract:** Two isolated bones of sea turtles from Algarrobo, in central Chile, are described.

23 A fragment of a flat element of Ypresian age is identified as part of a right hypoplastron,

24 referable to an indeterminate Pan-Chelonioidae. A second, large fragment from middle-to-
25 upper Eocene levels belonging to the second or fourth left costal of a carapace, preserves
26 distinctive features such as a considerable uniform thickness (5-7 mm), and a prominent
27 ventral rib ridge, plus scute sulci remarkably similar to extant Cheloniidae such as *Chelonia*
28 *mydas* or *Lepidochelys* spp. Based on these features, it is identified as an indeterminate Pan-
29 Cheloniidae. The studied material represents the first occurrences of sea turtles in the Eocene
30 of central Chile. The different ages of the specimens show the persistence of taxa related to
31 Pan-Chelonioidae throughout the Eocene in the southeastern Pacific, helping to fill the austral
32 geographic gap of the group during the Paleogene.

33 **Keywords:** Testudines, South Pacific, Paleogene, southern Hemisphere, Weddellian
34 Province.

35
36 **Primeros restos de tortugas marinas (Pan-Chelonioidae) en el Eoceno de Algarrobo,**
37 **Chile central.** Se describen en esta contribución dos huesos aislados de tortugas marinas
38 procedentes de Algarrobo, en Chile central. Un fragmento de un elemento plano de edad
39 ypresiana se identifica como parte de un hipoplastrón derecho, atribuible a un Pan-
40 Chelonioidae indeterminado. Un segundo fragmento de gran tamaño, procedente de niveles
41 del Eoceno medio a superior, pertenece al segundo o cuarto hueso costal izquierdo de un
42 caparazón, conservando rasgos distintivos como un considerable grosor uniforme (5-7 mm)
43 y una prominente cresta costal ventral, además de surcos de los escudos notablemente
44 similares a los de Cheloniidae actuales como *Chelonia mydas* o *Lepidochelys* spp. Sobre la
45 base de estas características, se identifica como un Pan-Cheloniidae indeterminado. El
46 material estudiado representa los primeros registros de tortugas marinas en el Eoceno de
47 Chile central. Las diferentes edades de los especímenes demuestran la persistencia de taxones

48 relacionados con Pan-Chelonioidea a lo largo del Eoceno en el Pacífico suroriental, lo que
49 contribuye a llenar el vacío geográfico austral del grupo durante el Paleógeno.

50 **Palabras clave:** Testudines, Pacífico Sur, Paleógeno, Hemisferio Sur, Provincia
51 Weddelliana.

52

53 **1. Introduction**

54

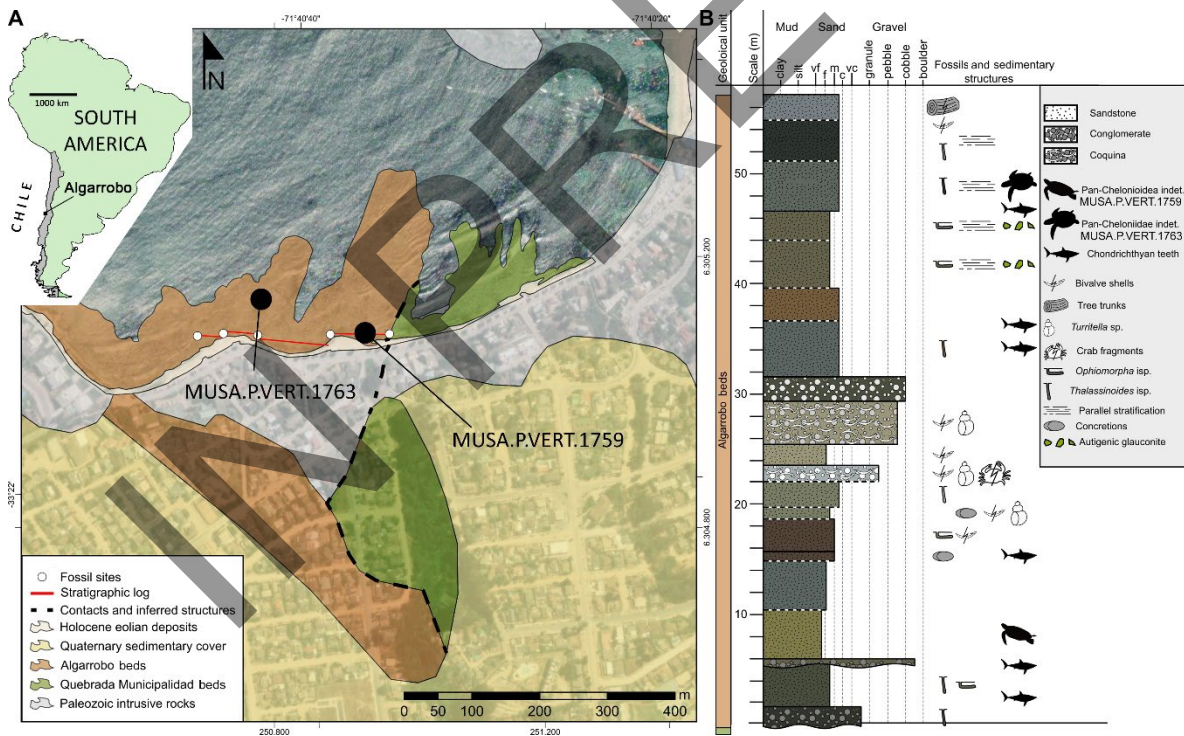
55 The fossil record of sea turtles from Chile is sparse and, to date, mostly restricted to few
56 Upper Cretaceous localities in the central part of the country. The oldest such records are
57 known for the lower Maastrichtian of the Valparaíso Region (Suárez et al., 2003; Otero et
58 al., 2012; Otero, 2024a), whereas upper Maastrichtian records are known in at least two
59 localities of the central-south Biobío Region (Biró-Bagóczy, 1982; Gasparini and Biró-
60 Bagóczy, 1986; Karl et al., 1998; Karl and Tichy, 2002; Parham et al., 2014) and in one
61 coeval locality of the central Maule Region (Suárez and Otero, 2008; Otero, 2024a). Despite
62 this known record, unpublished material indicates a geographically broader presence of sea
63 turtles throughout the Late Cretaceous, as suggested by a likely Maastrichtian record from
64 Isla Riesco, Magallanes Region in the south (S. Soto-Acuña, personal communication, 2020),
65 and during the Cenozoic, based on a single Neogene plate from the Bahía Inglesa Formation
66 near Caldera, in the northern Atacama Region (R. A. Otero, personal observation, 2009).

67 The present contribution describes the first post-Cretaceous sea turtle remains
68 recovered in central Chile (Algarrobo locality). Although fragmentary, the new material
69 helps fill in the geographic and chronostratigraphic gap in the group's presence along the
70 southeastern Pacific.

71

72 **2. Locality and geologic setting**

73 The coastal town of Algarrobo is in the Valparaíso Region, ~120 km west of Santiago (Fig.
74 1A). There, two marine units are exposed: the Quebrada Municipalidad beds (Gana et al.,
75 1996), of early Maastrichtian age (Brüggen, 1915; Tavera, 1980; Suárez and Marquardt,
76 2003), and the Algarrobo beds (Gana et al., 1996). The latter unit was constrained to the
77 middle-to-late Eocene based on biostratigraphy of marine invertebrates, being also correlated
78 with the Millongue Formation (Tavera, 1980). Ongoing studies in the Algarrobo beds show
79 that its basal part extends at least into the Ypresian (Otero, 2024b), so its chronostratigraphic
80 range would cover much of the Eocene series. In addition, it represents a shallow marine to
81 coastal environment proximal to a land drainage outlet.



82
83 **Fig. 1. A.** Map of Algarrobo, central Chile, indicating the sedimentary units exposed in its
84 coastline and the sample locations. Base satellite image from ArcGIS Pro 3.4 repository. **B.**
85 Stratigraphic log of the Algarrobo beds, reaching ~57 m in thickness, which represents the

86 lower two thirds of the unit. Stratigraphic level colours according to the Munsell Color (2010)
87 soil color charts standard for fresh exposures.

88 **3. Material and methods**

89

90 **Institutional abbreviations:** **MMSA.RE**, Exhibición, Museo de Historia Natural e
91 Histórico de San Antonio, San Antonio, Chile; **MUSA.P.VERT**, Colección Paleontología de
92 Vertebrados, Museo de Historia Natural e Histórico de San Antonio, San Antonio, Chile;
93 **NTUM-VP**, Vertebrate Paleontology (Laboratory of Evolution and Diversity of Fossil
94 Vertebrates), Museum of Zoology, National Taiwan University, Taipei, Taiwan; **Q**, Museo
95 Geológico Profesor Lajós Biró, Universidad de Concepción, Concepción, Chile; **SGO.PV**,
96 Área de Paleontología, Museo Nacional de Historia Natural, Santiago, Chile; **SMF R**,
97 Forschungsinstitut und Naturmuseum Senckenberg, Frankfurt, Germany.

98 **Material:** The two available bones were recovered in different field trips during July
99 2024 and July 2025, being previously noticed by nearby residents. MUSA.P.VERT.1759 was
100 recovered almost exposed on the surface, requiring minimal mechanical preparation with
101 hand tools. In contrast, MUSA.P.VERT.1763 was extracted partially embedded in the
102 sandstone matrix. The latter was left in a dry environment and protected from direct sunlight
103 in order to dry it naturally. Removal of recent algae on its exposed surface was done with
104 dental tools. The cracked surface was consolidated with B-72, applying this especially over
105 the sediment fill between each dorsal crack. After the fossil was naturally dried and cleaned,
106 its preparation was undertaken using the ME-9100 air scribe. A small amount of sediment
107 consolidated with paraloid was left over the ventral surface of the plate to preserve the
108 relative position of the naturally cracked fragments.

109 **Methods:** The recovered specimens were compared in terms of their osteology with
110 carapaces of extant sea turtles exhibited in the Museo de Historia Natural e Histórico de San
111 Antonio (MUSA). Taxonomic criteria follow the proposal of Joyce et al. (2004). Anatomical
112 nomenclature of the shell follows Zangerl (1969).

113

114 **4. Results**

115 **Systematic paleontology**

116 Diapsida Osborn, 1903

117 Testudines Batsch, 1788

118 Cryptodira Cope, 1868

119 Pan-Chelonioidea Joyce, Parham and Gauthier, 2004

120

121 **Pan-Chelonioidea indet.**

122 (Fig. 2)

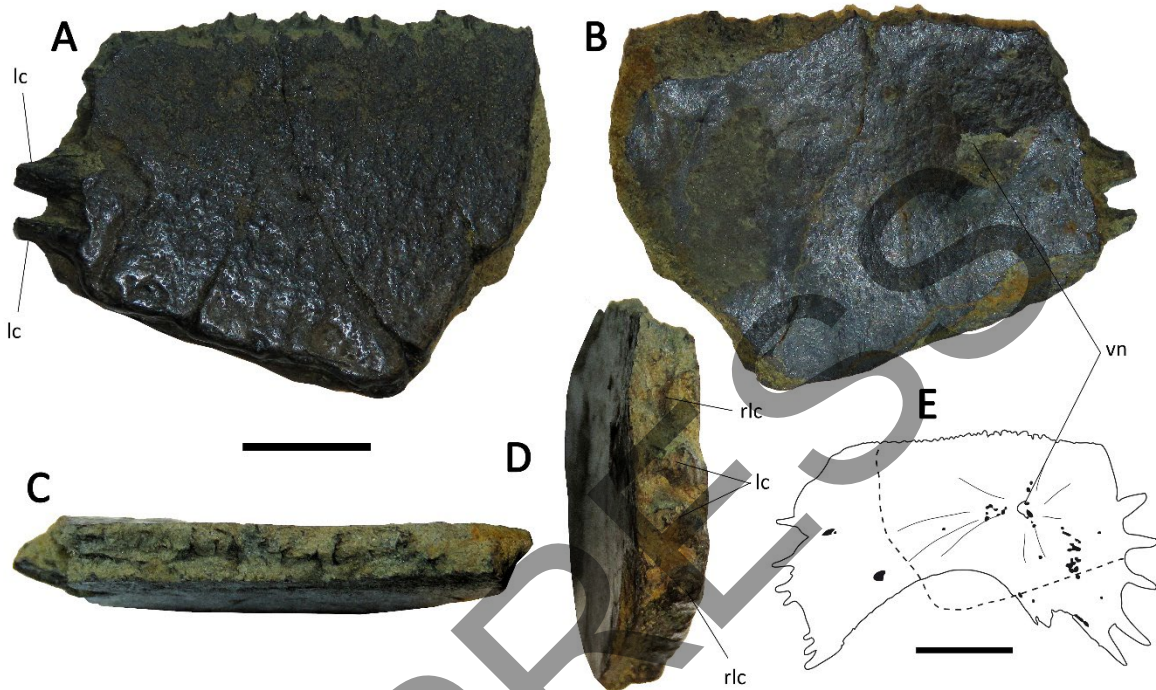
123

124 **Material:** MUSA.P.VERT.1759. Medial fragment of a right hypoplastron.

125 **Locality and horizon:** Los Tubos beach, Algarrobo, Valparaiso Region. Algarrobo
126 beds, lower levels. Ypresian (lower Eocene).

127 **Description:** The element (Fig. 2A-D) is a flat bone with a consistent thickness of ~5
128 mm. The larger preserved suture (identified here as the anterior margin) is highly indented
129 but retains a generally straight outline. The adjacent lateral margin (identified here as the
130 medial margin) shows two prominent projections. The other two remaining margins (lateral
131 and posterior) are eroded. The ventral (external) surface of the bone shows a notch over its

132 medial half. The opposite surface (dorsal/internal) is flat, without noticeable structures.
133 Several cracks are present on this side.
134



135
136 **Fig. 2. A-D.** MUSA.P.VERT.1759: Pan-Chelonioidea indet. Fragment of a right
137 hypoplastron in dorsal (internal) view (A). Same element in ventral (external) view (B).
138 Anterior profile of the sutural contact with the hypoplastron (C). View of the medial profile,
139 indicating the preserved stellate projections (lateral cornua), as well as those broken and
140 missing (D). **E.** Outline of the right hypoplastron of *Lepidochelys olivacea*, representing the
141 relative overlapping of the portion preserved in MUSA.P.VERT.1759 (the general
142 hypoplastron morphology slightly differs between the two); sketch modified from Liaw et al.
143 (2025, fig. 2E). Anatomical abbreviations: **lc**, lateral cornua (stellate projections); **rlc**,
144 remains of lateral cornua; **vn**, ventral notch. A-D, scale bar equals 10 mm; E, scale bar equals
145 5 cm.

146 **Laterality and anatomical identification:** A ventral notch over the ventral surface of
147 the hypoplastron (Fig. 2D, E) is a feature illustrated by Liaw et al. (2025, fig. 2E) for
148 *Lepidochelys olivacea* (NTUM-VP 2205281), although the anatomical description of this
149 feature is commonly ignored. Four stellate projections appear as short elements, because
150 these are incompletely preserved (distal tip missing). The small size of the bone also
151 correlates with a young individual where stellate projections could be briefly developed on
152 early ontogenetic stages. Nonetheless, the two preserved projections (plus two others only
153 represented by their broken attachments) in MUSA.P.VERT.1759 are consistent with the
154 stellate pattern (lateral cornua) of plastral elements (*i.e.*, hyoplastron and hypoplastron)
155 among Pan-Cheloniodea (Lehman and Tomlinson, 2004). The preserved sutured straight
156 margin, the articular facet and the stellate projections are all consistent with landmarks
157 present over the right hypoplastron of fossil and extant sea turtles (Hirayama, 1997, figs. 1-
158 5; Wyneken, 2001, fig. 97).

159 **Referral to Pan-Cheloniodea:** The almost straight anterior margin of the
160 hypoplastron (hyoplastron/hypoplastron suture) and the presence of medial projections are
161 features present among extant Pan-Cheloniidae (Wyneken, 2001, fig. 97; Cáceres et al., 2018,
162 fig. 6). Similar topologies are also present among fossil forms including Protostegidae,
163 Toxochelyidae and stem Dermochelyidae (Hirayama, 1997), with some taxa having a
164 hyoplastron/hypoplastron suture interrupted by a medial fossa (*e.g.*, *Toxochelys latiremis*,
165 *Allopleuron hofmanni*, *Santanachelys gaffneyi*, *Protostega gigas*; see Hirayama, 1997, figs.
166 1-3 and 5). Although incomplete, MUSA.P.VERT.1759 preserves its anteromedial margin
167 that proves the lack of a medial fossa, being more similar to extant pancheloniids of the
168 genera *Lepidochelys* and *Natator* (Lehman and Tomlinson, 2004, fig. 6). Due to its

169 incompleteness, the studied material is kept as an indeterminate Pan-Chelonioidea, although
170 it shows affinities to Pan-Cheloniidae.

171 A freshwater erratic origin of MUSA.P.VERT.1759 cannot be ruled out, but the
172 accumulated evidence regarding the environment of the unit (see Discussion, below) makes
173 a continental provenance unlikely.

174

175 Pan-Cheloniidae Joyce, Parham and Gauthier, 2004

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177 **Pan-Cheloniidae indet.**

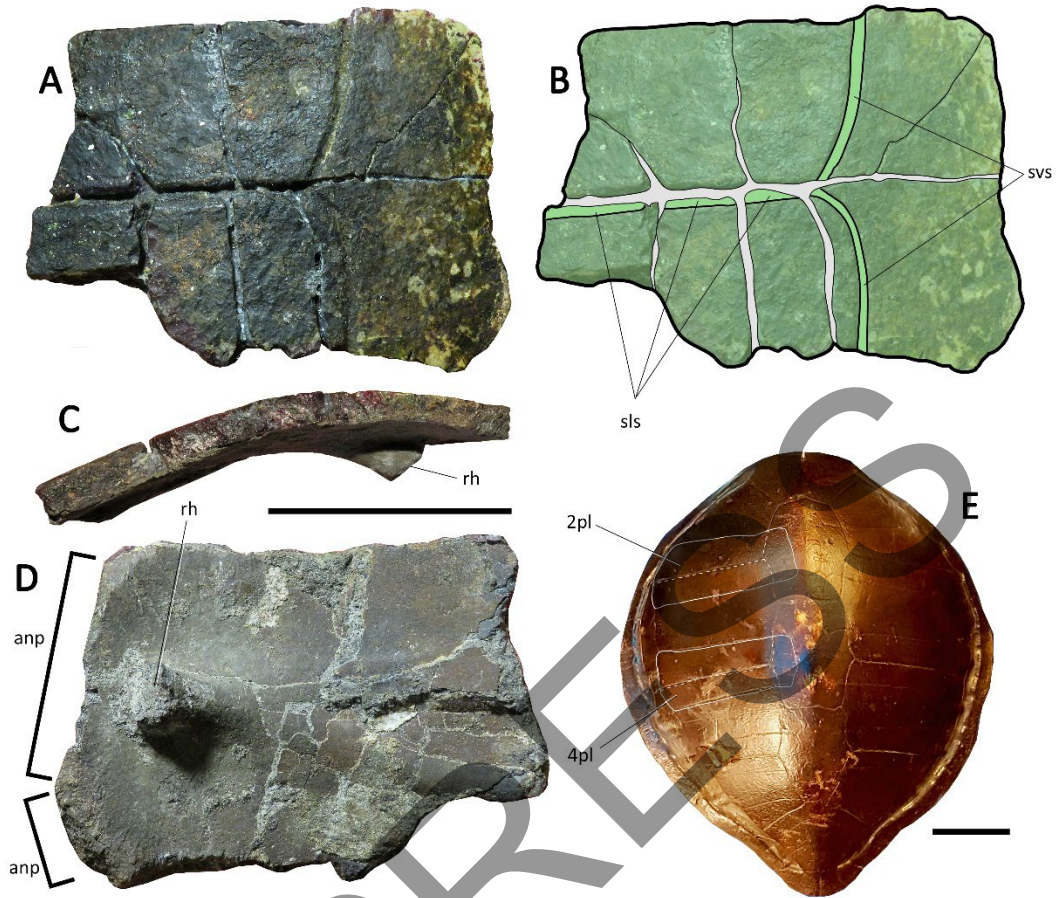
178 (Fig. 3)

179

180 **Material:** MUSA.P.VERT.1763. Second or fourth left costal (rib).

181 **Locality and horizon:** Los Tubos beach, Algarrobo, Valparaíso Region. Algarrobo
182 beds, upper levels. Middle-to-upper Eocene.

183 **Description:** The general contour of the costal is rectangular (Fig. 3A, B). Its ventral
184 surface preserves the rib head (Fig. 3C, D), while the midline rib ridge is partially crushed.
185 The dorsal surface of the costal is cracked in several parts and along its mid portion, showing
186 remains of an axial sulcus (sulcus between two successive lateral scutes). In its medial
187 portion, the lateral sulcus of a large vertebral scute is partially preserved. The medial and
188 anterior margins of the costal are almost complete. The first shows the sutural contact with
189 at least two neural plates (Fig. 3B, D), one of them covering about two thirds of the plate
190 cranio-caudal length. The remaining medial outline for the following neural plate shows a
191 different angle with regard to the almost straight, anterior, larger neural element. The pleural
192 thickness is uniform and reaches 5 to 7 mm.



193

194 **Fig. 3. A-D.** MUSA.P.VERT.1763: Pan-Cheloniidae indet. Second or fourth left costal in
 195 dorsal view (A). Anatomical schematic, highlighting the preserved sulci (light green) (B).
 196 Same element in craniocaudal profile (C). Ventral (internal) view (D). **E.** Carapace of
 197 *Chelonia mydas* (MMSA.RE.022, in exhibition at MUSA, 2025) indicating the position of
 198 the second and fourth costals in white contour. Dashed white lines indicate the sulci
 199 associated with the limits of the dermal scutes. Anatomical abbreviations: **2pl**, second costal;
 200 **4pl**, fourth costal; **anp**, articulation with neural plate; **rh**, rib head; **sls**, sulcus between lateral
 201 scutes; **svs**, lateral sulcus of the respective vertebral scute. A-D, scale bar equals 5 cm; E,
 202 scale bar equals 10 cm.

203

204

205 **Laterality and anatomical identification:** The straight rib head and its respective
206 ventral shaft preclude a posterior position of the plate, considering that rib heads and shafts
207 become posteriorly curved in the posterior half of the carapace (Márquez, 1990, fig. 11;
208 Wyneken, 2001, fig. 93a, b). The plate also has a medial sulcus consistently orientated with
209 the rib shaft (Fig. 3A, B). The partial vertebral scute scar can be separated into two halves,
210 each one with a different contour. Both halves have a similar cranio-caudal orientation, again
211 precluding a posterior position in the carapace, considering that the vertebral scute margins
212 acquire comparatively more acute angles in posterior positions (Wyneken, 2001, p. 4). The
213 curvature observed in lateral profile, plus the $\sim 100^\circ$ angle between the neural suture and the
214 unique complete axial margin, suggests that this costal is part of the anterior, left side of the
215 carapace. Compared to the extant carapace of *Chelonia mydas*, the sulci for the vertebral
216 plate are similar to those present in the dorsal surface of the second and fourth costal (Fig.
217 3E), reason why MUSA.P.VERT.1763 is identified as one of these elements.

218 **Referral to Pan-Cheloniidae:** MUSA.P.VERT.1763 possesses a uniform,
219 considerable thickness reaching 5 to 7 mm along the entire available plate. The presence of
220 a ventral rib ridge (crushed but visible) extended along the entire preserved costal fragment
221 strongly suggests that the rib shaft extended beyond the lateral margin, thus forming a
222 fenestration between the costal and the peripheral plates. These traits have been considered
223 typical of Pan-Cheloniidae (Joyce et al., 2004; Cadena et al., 2018). Based on these features,
224 MUSA.P.VERT.1763 is here referred to as Pan-Cheloniidae. The incompleteness of the
225 material precludes a genus referral.

226 **Comparisons:** Among extant sea turtles (except *Dermochelys coriacea*), the lateral
227 outline of the vertebral scutes is variable. Several factors including ontogenetic stage, sexual
228 dimorphism, and even epigenetic factors may lead to allometries on the scute outlines (Casale

229 et al., 2017). However, this variability is not linked to topology changes between the dermal
230 scutes and the underlying bony elements. Thus, it is possible to assess the relative position
231 of the scutes on the basis of the sulci preserved on the dorsal surface of MUSA.P.VERT.1763.

232 In this sense, second/fourth vertebral scutes with sharp lateral projections (as those
233 interpreted from MUSA.P.VERT.1763 preserved dorsal sulci) are commonly present among
234 adult individuals of the hawksbill turtle (*Eretmochelys imbricata*; Márquez, 1990, fig. 30)
235 and in the loggerhead turtle (*Caretta caretta*; Márquez, 1990, fig. 23). On the contrary,
236 vertebral scutes with comparatively straighter lateral outlines and similar to those of
237 MUSA.P.VERT.1763 are present in the green turtle (*Chelonia mydas*; e.g., MMSA.RE.022)
238 (Fig. 3E), Kemp's ridley turtle (*Lepidochelys kempii*; Márquez, 1990, fig. 33), and the olive
239 ridley turtle (*Lepidochelys olivacea*; Márquez, 1990, figs. 15-21).

240

241 5. Discussion

242 **Environment of the studied material:** The Algarrobo beds unit was undoubtedly
243 deposited in a marine environment, as evidenced by the abundant *in situ* invertebrate fauna
244 (Philippi, 1887; Brüggem, 1915; Tavera, 1980). Previous records of marine vertebrates in the
245 unit have been represented exclusively by marine forms (i.e., chondrichthyans; Suárez and
246 Marquardt, 2003), including recently recognized pelagic shark taxa (*Striatolamia macrota*,
247 *Cretolamna* sp., *Xiphodolamia* sp.; Otero et al., in press). While fragmentary driftwood is
248 present, the material is mostly represented by small chips and rarely by centimetric trunk
249 fragments invaded by *Teredolites* isp. (Tavera, 1980), the latter indicative of a long-term
250 buoyancy. On the other hand, the unit includes some levels with *in situ* banks of the gastropod
251 '*Turritella*' *landbecki* (Tavera, 1980). Regarding taphonomy, well-preserved chelipeds and
252 appendicular elements of decapods (Schweitzer et al., 2006), plus chondrichthyan teeth with

253 well-preserved delicate cusplets (Otero et al., in press), supports a general *in situ* occurrence
254 of both benthic and nektonic organisms (thus, including the material here studied).

255 **Previous sea turtle fossil record from Chile:** Gasparini and Biró-Bagóczy (1986)
256 described a mandible (Q.377), firstly referred to as *Osteopygis* sp. (currently, genus
257 *Euclastes*), from probable upper Maastrichtian beds of the Quiriquina Formation, in the
258 Biobío Region. A skull without mandible (SMF R 415) from the same unit was referred to
259 as *Osteopygoides* aff. *sculptus* by Karl et al. (1998). The same specimen was later considered
260 a Baenidae and reassessed as *Australobaena chilensis* by Karl and Tichy (2003). Suárez et
261 al. (2003) mentioned plates and figured a fragmentary humerus from lower Maastrichtian
262 beds in Algarrobo. Later, Suárez and Otero (2008) described fragmentary plates referred to
263 as *Chelonioidea* indet. (SGO.PV.6503 and 6504) from upper Maastrichtian beds of the
264 Quiriquina Formation in Loanco, Maule Region. Then, complementary material
265 (SGO.PV.6573 and 6768) from the lower Maastrichtian of Algarrobo was initially referred
266 to as cf. *Dermochelyidae* indet. (Otero et al., 2012) and more recently to *Mesodermochelys*
267 sp. (Otero, 2024a). Parham et al. (2014) described a new skull (SGO.PV.6504) of the genus
268 *Euclastes*, from upper Maastrichtian levels of the Quiriquina Formation exposed in
269 Cocholgüe, Biobío Region. Parham et al. (2014) discussed the taxonomic status of
270 *Australobaena chilensis*, expressing doubts about the genus and species referral. They also
271 commented that its skull as well as the jaw described by Gasparini and Biró-Bagóczy (1986)
272 indeed matched the relative bone proportions of the genus *Euclastes*. Karl et al. (2024) re-
273 described the skull of *Australobaena chilensis* using photographs, adopting the family-level
274 referral to Pan-Cheloniidae as previously proposed by Parham et al. (2014).

275 In summary, the Upper Cretaceous sea turtle record from central Chile is to date
276 characterized exclusively by Pan-Chelonioidea of the clades Euclastidae (*sensu* Lapparent

277 de Broin et al., 2025) and Dermochelyidae (=Pandermochelys, *sensu* Joyce et al., 2004). The
278 new discoveries signify the local presence of Pan-Cheloniidae (at least) beginning in the
279 Ypresian. While MUSA.P.VERT.1763 cannot be assigned to any genus due to its
280 incompleteness, its broad shape contacting both anterior and posterior successive costals,
281 plus the sulci for the vertebral scutes, obviates its referral as Pandermochelys. The latter clade
282 has a soft carapace lacking large dermal scutes, while the bony carapace is conformed by a
283 mosaic of small ossicles instead of cranio-caudally extended costal bones (Marquez, 1990;
284 Wyneken, 2001).

285 **Paleobiogeography:** In South America, Cenozoic Pan-Cheloniidae are documented
286 in the Paleocene of Argentine Patagonia with the species *Erquelinnesia meridionalis* (de la
287 Fuente and Casadío, 2000; after Parham and Pyenson, 2010), with a major local gap during
288 the Eocene. Geographically closer to the study area, Eocene records are represented by
289 remains of indeterminate Dermochelyidae from southernmost South America (Bona et al.,
290 2024), and the Antarctic Peninsula (de la Fuente et al., 1995; Albright et al., 2003). Few
291 Oligocene records are known along the southeastern Pacific: in Peru, undescribed sea turtle
292 remains from the Oligocene-Miocene (Brand et al., 2011; Cadena et al., 2018) have been
293 recognized, as well as remains of an indeterminate Pan-Cheloniidae of late Oligocene age
294 (Cadena et al., 2018). Miocene Pan-Cheloniidae are documented in Peru, with the species
295 *Pacificchelys urbinai* Parham and Pyenson, 2010, and the dermochelyid *Natemys peruvianus*
296 Wood et al., 1996. In Chile, there is unpublished material from the Miocene of the Navidad
297 Formation (housed at Museo Nacional de Historia Natural, Santiago, Chile) and the Miocene-
298 Pliocene Bahía Inglesa Formation (housed in the Museo Paleontológico de Caldera), which
299 likely represent additional records of Pan-Cheloniidae (R. A. Otero, personal observation,
300 2009).

301 The specimens studied here represent the very first Eocene records of sea turtles in
302 the southeastern Pacific, adding to other coeval records from the Austral basin of southern
303 South America, the Antarctic Peninsula, and New Zealand. These records, to date, are mostly
304 represented by indeterminate *Pandermochelys* (de la Fuente et al., 1995; Köhler, 1995;
305 Albright et al., 2003, Bona et al., 2024), and eventually by forms resembling Pan-
306 *Cheloniidae*, based on the presence of well-ossified peripheral plates (see Bona et al., 2010).

308 **6. Conclusions**

309
310 This contribution presents two fragmentary bones of sea turtles recovered from the
311 Paleogene Algarrobo beds, at Algarrobo, central Chile. A partial right hypoplastron from
312 Ypresian levels is here referred to as an indeterminate Pan-*Chelonioidea*, showing affinities
313 to extant Pan-*Cheloniidae*. A second, larger plate from middle-to-upper Eocene levels, is here
314 identified as the second or fourth left pleural, based on its distinctive sulci for the vertebral
315 scutes, similar to those present in extant representatives of the genus *Lepidochelys* and in
316 *Chelonia mydas*.

317 The described material represents the first record of Pan-*Chelonioidea*/Pan-
318 *Cheloniidae* sea turtles in the Eocene of the southeastern Pacific, helping to fill a major
319 geographic and chronostratigraphic gap in the austral fossil record of the group. The current
320 specimens also increase the austral diversity by adding the first confirmed Eocene non-
321 *Pandermochelys* sea turtles of the southern hemisphere. It also extends the continuous
322 presence of Pan-*Cheloniidae* along the southeastern Pacific at least from the Ypresian to the
323 Neogene, based on previous, northern records.

324

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334
335 **References**

- 336
337 Albright, L.B.; Woodburne, M.O.; Case, J.; Chaney, D.S. 2003. A leatherback sea turtle from
338 the Eocene of Antarctica: implications for antiquity of gigantothermy in Dermochelyidae.
339 *Journal of Vertebrate Paleontology* 23: 945-949. <https://doi.org/10.1671/1886-19>
- 340 Batsch, A.J. 1788. *Versucheiner Anleitung, zur Kenntniß und Geschichte der Tiere und*
341 *Mineralien*. Akademische Buchhandlung, Jena, p. 528.
- 342 Biró Bagóczy, L. 1982. Revisión y redefinición de los 'Estratos de Quiriquina',
343 Campaniano-Maastrichtiano, en su localidad tipo, en la Isla Quiriquina, 36°37' Lat. Sur,
344 Chile, Sudamérica, con un perfil complementario en Cocholgue. In: III Congreso
345 Geologico Chileno (Concepción), Actas 1, pp. A29-A64.
- 346 Bona, P.; de la Fuente, M.; Reguero, M.A. 2010. New fossil turtle remains from the Eocene
347 of the Antarctic Peninsula. *Short Note, Antarctic Science* 22:531-532.
348 <https://doi.org/10.1017/S0954102010000362>

349 Bona, P.; Sterli, J.; De la Fuente, M.; Olivero, E.; Fernández, M.; Reguero, M. 2024. The
350 first record of dermochelyid turtles in the Eocene of Tierra del Fuego: new insights on the
351 evolution of the Weddellian faunas. *Advances in Polar Science* 35:63-77. doi:
352 10.12429/j.advps.2023.0026

353 Brand, L.; Urbina, M.; Chadwick, A.; DeVries, T.J.; Esperante, R. 2011. A high resolution
354 stratigraphic framework for the remarkable fossil cetacean assemblage of the
355 Miocene/Pliocene Pisco Formation, Peru. *Journal of South American Earth Sciences*
356 31:414-425. <https://doi.org/10.1016/j.jsames.2011.02.015>

357 Brüggén, J. 1915. *El Cretáceo de Algarrobo*. Sociedad Imprenta Litográfica Barcelona,
358 Santiago-Valparaíso, 15 pp.

359 Cáceres, B.; Aguayo Lobo A.; Scholfield, D.; Arcos F.; Muñoz, N.; Cabello, J.; Acevedo, J.
360 2018. New record of black turtle *Chelonia mydas agassizii* in high latitudes of eastern
361 South Pacific Ocean. *Journal of Life Sciences* 12:150-158. [https://doi.org/10.17265/1934-](https://doi.org/10.17265/1934-7391/2018.03.005)
362 [7391/2018.03.005](https://doi.org/10.17265/1934-7391/2018.03.005)

363 Cadena, E.; Abella, J.; Gregori, M. 2018. The first Oligocene sea turtle (Pan-Cheloniidae)
364 record of South America. *PeerJ* 6:e4554, 10 p. <https://doi.org/10.7717/peerj.4554>

365 Casale, P.; Freggi, D.; Rigoli, A.; Ciccocioppo, A.; Luschi, P. 2017. Geometric
366 morphometrics, scute patterns and biometrics of loggerhead turtles (*Caretta caretta*) in
367 the central Mediterranean. *Amphibia-Reptilia* 38: 145-156.
368 <https://doi.org/10.1163/15685381-00003096>

369 Cope, E.D. 1868. On the origin of genera. *Proceedings of the Academy of Natural Sciences*
370 of Philadelphia 1868: 242-300.

371 de la Fuente, M.; Casadio, S. 2000. Un nuevo osteopigino (Chelonii: Cryptodira) de la
372 Formación Roca (Paleoceno inferior) de Cerros Bayos, provincia de La Pampa, Argentina.
373 Ameghiniana 37:235-246.

374 de la Fuente, M.S.; Santillana, S.; Marensi, S.A. 1995. Eocene leatherback turtle
375 (Cryptodira: Dermochelyidae) from Seymour Island, Antarctica. Studia Geologica
376 Salmanticensia 31:17-30.

377 Gana, P.; Wall, R., Gutierrez, A., 1996. Mapa Geológico del área de Valparaíso-Curacaví,
378 Región de Valparaíso y Región Metropolitana. Servicio Nacional de Geología y Minería
379 (Chile), Mapas Geológicos N °1, Escala 1:100.000, Santiago, 20 p.

380 Gaspirini, Z., Biro-Bagóczy, L., 1986. *Osteopygis* sp. (Reptilia, Testudines, Toxochelyidae)
381 tortuga fósil de la Formación Quirquina, Cretácico Superior, sur de Chile. Revista
382 Geológica de Chile 27:85-90.

383 Hirayama, R., 1997. Distribution and diversity of Cretaceous chelonoids. In: Callaway, J.M.,
384 Nicholls, E.L., eds. Ancient Marine Reptiles. Academic Press, New York, 225-241.

385 Joyce, W.G., Parham, J.F., Gauthier, J., 2004. Developing a protocol for the conversion of
386 rank-based taxon names to phylogenetically defined clade names, as exemplified by
387 turtles. Journal of Paleontology 78:989-1013. [https://doi.org/10.1666/0022-](https://doi.org/10.1666/0022-3360(2004)078<0989:DAPFTC>2.0.CO;2)
388 [3360\(2004\)078<0989:DAPFTC>2.0.CO;2](https://doi.org/10.1666/0022-3360(2004)078<0989:DAPFTC>2.0.CO;2)

389 Karl, H.V., Tichy, G., 2002. *Australobaena chilensis* n. gen. n. sp., and the homology of
390 secondary palatines in marine turtles (Anapsida: Testudines). Studia Geologica
391 Salmanticensia 38:11-19.

392 Karl, H.V., Tichy, G., Ruschak, H., 1998. *Osteopygoides priscus* n. gen. n. sp. und die
393 Taxonomie und Evolution der Osteopygidae (Testudines: Chelonioidea). Mitteilungen der
394 Geologischen und Paläontologischen Landesmuseum Joanneum 56:329-350.

395 Karl, H.V.; Safi, A.; Tichy, G. 2024. Cranial anatomy and holotype reconstruction of the
396 Late cretaceous turtle, *Australobaena chilensis* from the Quiriquina Formation, Chile.
397 Mesozoic 001:474-482. <https://doi.org/10.11646/mesozoic.1.4.5>

398 Köhler, R., 1995. A new species of the fossil turtle *Psephophorus* (Order Testudines) from
399 the Eocene of the South Island, New Zealand. Journal of The Royal Society of New
400 Zealand 25: 371-384. <https://doi.org/10.1080/03014223.1995.9517495>

401 Lapparent de Broin, F.; Marek, H.; Barrier, P.; Gagnaison, C. 2025. Euclastidae n. fam.
402 (Chelonioidea) et première mention d'*Euclastes* Cope, 1867 dans le Paléocène du bassin
403 de Paris (France). Geodiversitas 47: 409-464.
404 <https://doi.org/10.5252/geodiversitas2025v47a10>

405 Lehmann, T.M., Tomlinson, S.L., 2004. *Terlinguachelys fischbecki*, a new genus and species
406 of sea turtle (Chelonioidea: Protostegidae) from the Upper Cretaceous of Texas. Journal
407 of Paleontology 78: 1163-1178. [https://doi.org/10.1666/0022-3360\(2004\)078<1163:TFANGA>2.0.CO;2](https://doi.org/10.1666/0022-3360(2004)078<1163:TFANGA>2.0.CO;2)

409 Liaw, Y-L.; Chuang, C-K.; Tsai, C-H. 2025. The first fossil loggerhead sea turtle
410 (Cheloniidae: *Caretta*) from the North Pacific and its nannofossil biostratigraphy. Swiss
411 Journal of Palaeontology 144:42, 11 p. <https://doi.org/10.1186/s13358-025-00392-3>

412 Márquez, R. 1990. Sea turtles of the world. An annotated and illustrated catalogue of sea
413 turtles species known to date. Food and Agriculture Organization of the United Nations,
414 Vol. 11. 87 p. Rome.

415 Munsell Color. 2010. Munsell soil color charts: with genuine Munsell color chips. Grand
416 Rapids, MI, USA. 12p.

417 Osborn, H.F., 1903. The reptilian subclasses Diapsida and Synapsida and the early history of
418 the Diaptosauria. Memoirs of the American Museum of Natural History 1, 451–507.

419 Otero, R.A., Parham, J.F., Soto-Acuña, S., Jimenez-Huidobro, P., Rubilar-Rogers, D., 2012b.
420 Marine reptiles from the Late Cretaceous (early Maastrichtian) of Algarrobo, central
421 Chile. *Cretaceous Research* 35, 124–132. <https://doi.org/10.1016/j.cretres.2011.12.003>

422 Otero, R.A. 2024a. Review of two marine vertebrate assemblages from the Arauco Basin
423 (central Chile) reveals diversity changes throughout the Maastrichtian. *Cretaceous*
424 *Research* 166: 34 p. <https://doi.org/10.1016/j.cretres.2024.105996>

425 Otero, R.A. 2024b. Primera diversidad de condriictios del Eoceno de Algarrobo, Región de
426 Valparaíso. Primer Congreso Chileno de Zoología, Libro de Resúmenes, pp. 138-139.
427 Talca.

428 Otero, R.A., Soto Acuña, S. Ugalde, R. Ortiz, H. In press. A Paleogene chondrichthyan
429 assemblage from central Chile supports a latitudinal and temporal boundary of the
430 Weddellian Province along the southeastern Pacific. *Acta Palaeontologica Polonica*.

431 Parham, J.F.; Pyenson, N. 2010. New Sea Turtle from the Miocene of Peru and the Iterative
432 Evolution of Feeding Ecomorphologies since the Cretaceous. *Journal of Paleontology*
433 84:231-247. <https://doi.org/10.1666/09-077R.1>

434 Parham, J.F., Otero, R.A., Suárez, M.E., 2014. A Sea Turtle Skull from the Late Cretaceous
435 of Chile with Comments on the Taxonomy and Biogeography of *Euclastes* (formerly
436 *Osteopygis*). *Cretaceous Research* 49, 181–189.
437 <https://doi.org/10.1016/j.cretres.2014.03.004>

438 Schweitzer, C.E., Feldmann, R.M., Encinas, A., Suárez, M. 2006. New Cretaceous and
439 Eocene Callianassoidea (Thalassinidea, Decapoda) from Algarrobo, Chile. *Journal of*
440 *Crustacean Biology* 26: 73-81. <https://doi.org/10.1651/C-2603.1>

- 441 Suárez, M.E.; Marquardt, C. 2003. Revisión preliminar de las faunas de peces
442 elasmobranquios del Mesozoico y Cenozoico de Chile. Congreso Geológico Chileno n°
443 10, Sesión temática 3, Paleontología. Actas, CD-ROM, 9 pp. Concepción.
- 444 Suárez, M.E., Otero, R.A., 2008. Nuevos hallazgos de vertebrados marinos en el
445 Campaniano–Maastrichtiano de Loanco, VII Región. I Simposio de Paleontología en
446 Chile, Santiago, Actas, 78–82.
- 447 Suárez, M.E.; Quinzio, L.A.; Fritis, O.; Bonilla, R. 2003. Aportes al conocimiento de los
448 vertebrados marinos de la Formación Quiriquina. Congreso Geológico Chileno n° 10,
449 Sesión temática 3, Paleontología. Actas, 7 pp. Concepción.
- 450 Tavera, J. 1980. Cretáceo y Terciario de la localidad de Algarrobo. Imprentas Gráficas
451 Conchalí, 45 pp. Santiago.
- 452 Wood, R.C.; Johnson-Gove, J.; Gaffney, E.S.; Maley, K.F. 1996. Evolution and phylogeny
453 of Leatherback turtles (Dermochelyidae), with descriptions of new fossil taxa. *Chelonian*
454 *Conservation and Biology* 2:266-286.
- 455 Wyneken, J., 2001. The anatomy of sea turtles. U.S. Department of Commerce NOAA
456 Technical Memorandum NMFS-SEFSC-470, 172 pp.
- 457 Zangerl, R. 1969. The turtle shell. In: Gans, C.; Belairs, d'A., eds. *The Biology of the Reptilia*,
458 Vol 1. Academic Press, New York, pp. 311-399.